

# Coal seam gas developments - predicting impacts

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Coal seam gas (CSG) is a form of natural gas that is extracted from underground coal seams. This factsheet outlines reasons for using natural gas as an energy source, some of the potential impacts of CSG developments and challenges associated with predicting these impacts.

## Natural gas as an energy source

Natural gas extracted from coal seams can offer a number of benefits as an energy source:

- ◆ natural gas typically burns more efficiently than coal or oil and can emit less greenhouse gas at the points of extraction and combustion
- ◆ natural gas has a role in supporting the journey towards lower or zero emission renewable energy sources
- ◆ natural gas has direct use for a range of purposes such as heating and for powering fast-response, electricity-generating turbines
- ◆ Australia has abundant resources of natural gas
- ◆ gas can be piped to a liquefied natural gas (LNG) plant where it can be processed into LNG for export
- ◆ the CSG export trade provides jobs and revenue to Australia.

## Regulation of CSG developments

Regulation of CSG operations is undertaken by relevant state and environmental authorities.

These authorities establish regulatory frameworks based on the evaluation of potential environmental risks and hazards of proposed developments.

Applying comprehensive science can give insights into the likely risks and impacts associated with individual CSG operations.

## Predicting impacts

Predicting long-term impacts of CSG production can be difficult due to potential cumulative and region-specific impacts of multiple developments.

Estimating social and environmental impacts for a given time and place is challenging because of variation in the:

- ◆ nature of land use in surrounding areas
- ◆ amount, density and location of surface infrastructure required
- ◆ geology
- ◆ hydrodynamics
- ◆ economics and logistics of producing and transporting the gas
- ◆ the range of management and monitoring practices in place.



Figure 1. Coal seam gas developments are associated with a range of social, environmental and economic impacts (photo source: Australia Pacific LNG).

## Groundwater modelling

Modelling of groundwater systems can help to predict potential impacts of CSG development on water systems.

Modelling large groundwater systems such as the Surat, Bowen and Great Artesian Basins is challenging due to the size of the basins and scarcity of groundwater data in sparsely populated regions.

However, the general principles of hydrology are well understood. Insights into groundwater behaviour have been gained by analysing the impacts of historical water extraction in the Great Artesian Basin.

Prediction of specific impacts of CSG developments requires ongoing research because groundwater responses may take decades or centuries to move through aquifers, especially when groundwater flow velocities are slow.

## Environmental impacts

The potential environmental impacts of CSG developments will depend on the volume and quality of produced water, its treatment, and the extent of built infrastructure associated with CSG operations.

## Water quantity

Typically, large amounts of water are produced during the process of CSG extraction. In Queensland, the average well has produced around 20,000 litres of water each day, although this can vary widely among individual wells.

Depending on the site, the removal of large quantities of water may affect the levels and flow of groundwater in surrounding aquifer systems, which may influence the levels of nearby bore water.

Extraction of large volumes of groundwater may also cause some surface subsidence, depending on the site.

### Water quality and treatment

Water produced from CSG production differs in quality from site to site but is normally brackish (about one-sixth the salinity of sea water). It typically contains sodium chloride, dissolved sodium bicarbonate and traces of other compounds.

Treatment of the produced water enables it to be used for a variety of surface uses or for aquifer recharge. This energy intensive process increases the financial and carbon costs of CSG extraction.

Treating the water also typically produces a waste stream of super saline brine that needs to be disposed of or further treated to produce commercially usable salts.

### Water use and disposal

Following treatment of extracted water to remove salts and balance acidity, the potential impacts of this water on agricultural production and ecosystem function are likely to be manageable, e.g. through appropriate mechanisms for its use or disposal.

If treated and used appropriately, the water can potentially be used as a resource for agriculture.

### Groundwater contamination

Groundwater contamination from CSG operations is considered a low risk. This is because:

- ♦ Hydraulic fracturing, when conducted correctly, is unlikely to introduce hazardous concentrations of chemicals into groundwater or to create connections between fresh and coal-containing aquifers. Most of the chemicals are of low inherent toxicity, undergo considerably dilution, and the majority (60-80 per cent) are understood to be removed during flow back of the hydraulic fracturing fluid to the well from the coal seam. It is possible to further reduce risks of contamination by restricting hydraulic fracturing to coal seams that are isolated from surrounding aquifers by substantial aquitards.
- ♦ Water extraction from coal seams makes cross-contamination of aquifers unlikely; most of the inter-aquifer transfer will be of higher quality water into neighbouring coal measures as water flows from high to low pressure. This may result in groundwater depression and reduced volume in fresh water aquifers.

Long-term monitoring of well bore integrity can help to identify the potential for well leakage into surrounding aquifers.

### Infrastructure footprint

Current CSG developments in Queensland comprise around 4000 wells.

If the industry reaches its maximum predicted scale, a total of 40,000 wells may be sunk, typically to depths of 300-1000 metres below the surface.

Wells are often laid out on a grid separated by about 750 metres, connected by a network of roads, pipelines and compressor stations.

The surface footprint of CSG infrastructure is generally less intensive than other industries such as mining.

However, the distribution of developments may fragment local habitat and agricultural landscapes and may compromise the scenic and aural quality of the landscape.

### Social issues

In Australia, a number of significant CSG fields underlie agricultural land and will draw upon existing infrastructure and social services.

Social impacts from CSG developments are likely to flow from:

- ♦ the access and use of land and water resources
- ♦ competing demands placed on human capital and social infrastructure
- ♦ challenges to existing rural community identities and ways of life.

The rapid influx of relatively high-income residents can result in a sharp increase in competition among residents for social and natural resources. This can create tensions at local and regional scales.

The set of potentially negative and positive impacts are not uniformly distributed across space and time. Spatially, most negative impacts are accrued locally, and may not be off-set by substantial positive impacts that accrue at larger regional scales.

CSG operations will upscale and downscale over time, altering the distribution of wealth to different stakeholders and regions and influencing the local availability of natural and social resources such as water or housing.

Individuals and communities have motivations beyond economic concerns. Identities and affinities associated with activities and lifestyles such as 'farming', 'rural life' and 'life on the land' are powerful dimensions of the way in which communities perceive and understand CSG development and their potential impacts. They are therefore a component of concerns and protests about CSG.

CSG development is capital and labour intensive and creates significant demands for human and physical resources and can, as a consequence, test the capacity of local and regional governance to manage social and economic transformation, during both the upscaling and downscaling of development.

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